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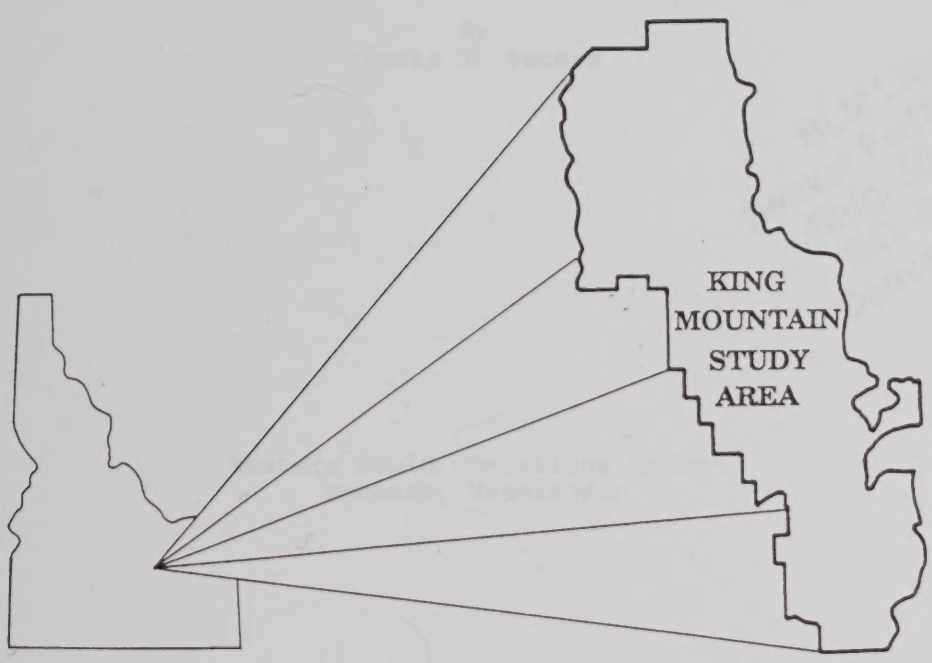

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

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MINERAL RESOURCES OF THE KING MOUNTAIN STUDY AREA

BUTTE COUNTY, IDAHO

By
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PREFACE

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Bureau of Mines and U.S. Geological Survey to survey certain areas of Federal lands ". . . to determine the mineral values, if any, that may be present . . ." Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a Bureau of Mines mineral investigation of the King Mountain study area, Butte County, Idaho, which includes lands recommended for Wilderness. Mining-related activities in the study area would be severely restricted under wilderness designation.

This open-file report contains data gathered and interpreted by personnel of the Bureau of Mines, Western Field Operations Center, Branch of Resource Evaluation, East 360 Third Avenue, Spokane, WA 99202. The report has not been edited or reviewed for conformity with Bureau of Mines editorial standards.

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UNITS OF MEASURE, ABBREVIATIONS, SYMBOLS AND CONVERSIONS USED IN THIS REPORT

To conform to the Omnibus Trace and Competitiveness Act of 1988 and Executive Order 12770, dated July 25, 1991, measurements made during this study have been converted to the metric system. Conversions have been done using Federal Standard a, May 5, 1983, preferred metric units for general use by the Federal Government, general Services Administration (GSA). Some information in the appendices, which was copied from other sources, has been left in its original measurement system. Significant precious-metals concentrations are shown in both metric and English units.

Metric Units

C	Celsius
cm	centimeter (cm_3 x 0.3937 = inch)
m^3	cubic meter (m^3 x 1.3079 = yd^3)
g	gram (g x 0.029 = oz)
ha	hectare (ha x 2.471 = acre)
<	less than
>	larger than
m	meter (m x 3.28 = ft)
t	metric ton (tonne) (t x 0.9072 = ton)
kg	kilogram (kg x 2.205 = lb)
km	kilometer (km x 0.6214 = mi)
ppb	part per billion
ppm	part per million
%	percent

English

F	Fahrenheit
yd^3	cubic yard
ft	foot
mi	mile
oz	troy ounce
oz/ton	troy ounce per short ton
T. 9 N.	Township 9 north
R. 27 E.	Range 27 east
Sec.	Section

SUMMARY

The King Mountain study area is centered about 120 air km northwest of Blackfoot, and 30 air km north of Arco, Idaho. The study area makes up the southern one-third of the northwest-trending Lost River Range--the highest mountain range in Idaho.

The area is predominantly underlain by Paleozoic-age marine limestone and lesser dolostone, with a relatively small inlier of silica-rich, Ordovician-age quartzite. There are vast, un-quantified resources of these industrial minerals present; however, special markets need to be developed for these resources which are near enough for transportation costs to be competitive. Five prospects were found in the study area; however, only one, the Elbow quartz silica prospect, contains resources and current claims. There has been no mineral production in the study area.

INTRODUCTION

This report is part of the USBM (U.S. Bureau of Mines) Idaho Land Assessment Program to study the mineral resources of priority roadless areas in Idaho. The results of mineral inventories on specific study areas, such as King Mountain, provide minerals information needed by the President, the Congress, land management agencies, and ultimately, by the public, to make wise decisions regarding future land management practices. The information also helps fulfil a long-term Bureau of Mines objective, to ensure the nation has an adequate dependable supply of minerals at a reasonable cost.

Geographic Setting

The King Mountain study area, encompassing about 31,800 hectares of the Challis National Forest, is in southern Idaho's Butte County about 120 air-km north of Blackfoot and 30 air-km north of Arco (fig. 1). Principal road access is by Butte County and Forest Service roads from U.S. Highway 93 northwest of Arco, and county and forest roads northwest from Howe, on Idaho Highway 33 northeast of Arco.

The study area encompasses the southern one-third of the northwest-trending Lost River Range, which is the highest mountain range in Idaho. Elevations in the study area range from 1,830 m at several locations along the southwest boundary to 3,377 m at an unnamed mountain near the center of the area.

Scattered groves of ponderosa pine and grass cover south-facing slopes. North-facing slopes are more heavily timbered and also include Douglas fir and lodgepole pine. Black cottonwood and aspen occur along streams.

Average low temperature in January is about -16°C (Celsius), and normal maximum temperature in July is 29°C. Normal annual precipitation is about 23 cm; the wettest month is March, with 2.5 cm of precipitation (National Oceanic and Atmospheric Administration (1974, p.647-653). Snow restricts travel in the high country from November through April.

Previous Studies

An overview of the mineral resource potential of national forest RARE II areas in Idaho was provided by Nevins and Oakman (1988). The geology and mineral potential of the Challis National Forest was studied by Worl and others (1989), and a mineral resource appraisal of the forest was done by McHugh and others (1991). Other mineral resource appraisals of Challis Forest and BLM (U.S. Bureau of Land Management) lands within the

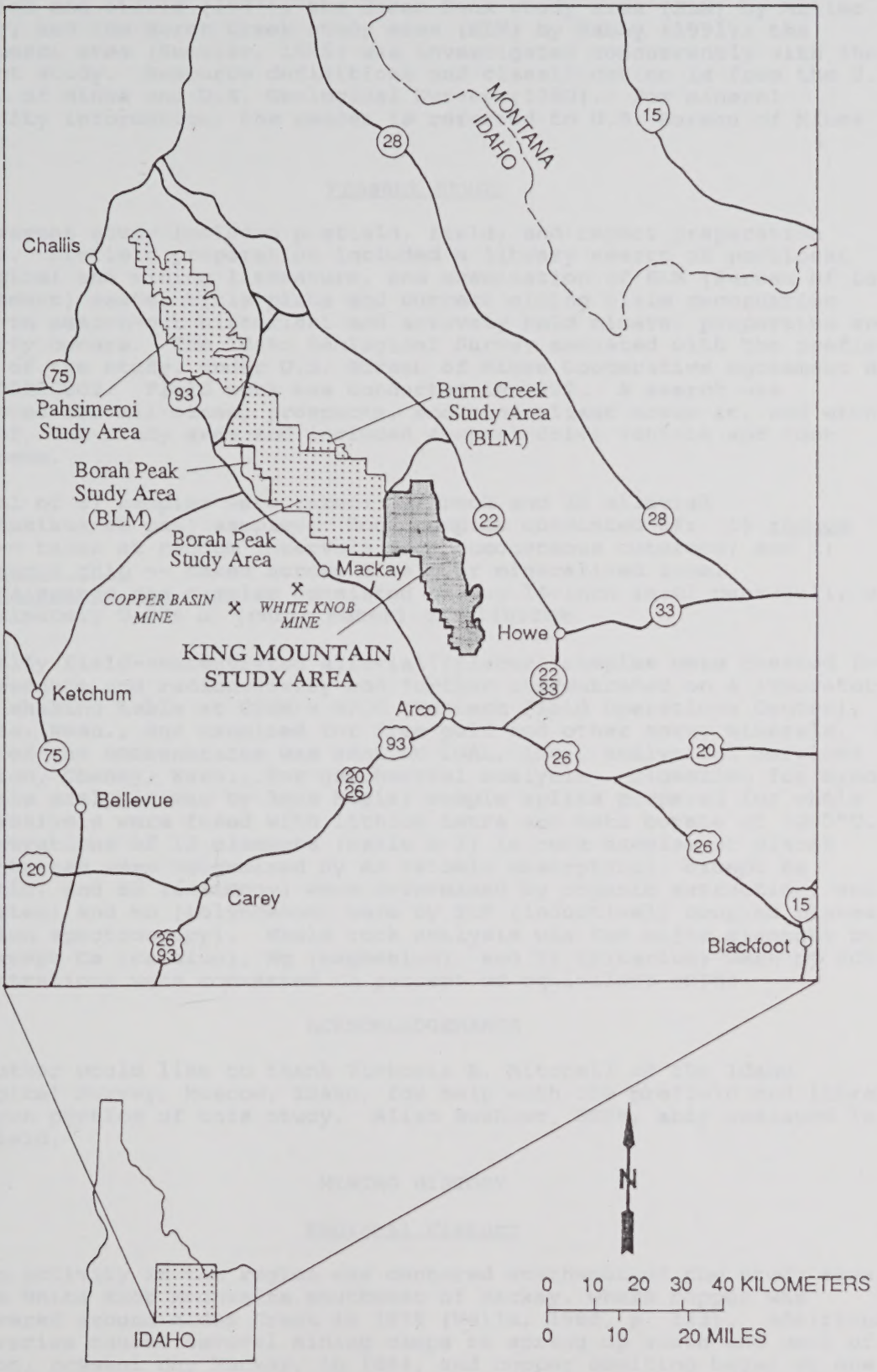

Figure 1.- Location of the King Mountain study area, Butte County, Idaho

Lost River Range include the Borah Peak study area (Forest Service) by Capstick and others (1987), the Borah Peak study area (BLM) by Miller (1989), and the Burnt Creek study area (BLM) by Gabby (1991); the Pahsimeroi area (Buehler, 1993) was investigated concurrently with the present study. Resource definitions and classification is from the U.S. Bureau of Mines and U.S. Geological Survey (1980). For mineral commodity information, the reader is referred to U.S. Bureau of Mines (1993).

Present Study

The present study included prefield, field, and report preparation phases. Prefield preparation included a library search of pertinent geological and mining literature, and examination of BLM (Bureau of Land Management) master title plats and current mining claim recordation data, to search-out historical and actively held mineral properties and property owners. The Idaho Geological Survey assisted with the prefield phase of the study, under U.S. Bureau of Mines Cooperative Agreement No. 1432-C0220002. Field work was conducted in 1992. A search was conducted for all mines, prospects, and mineralized areas in, and within 2 km of, the study area and included 4-wheel-drive vehicle and foot traverses.

A total of 57 samples were taken: 24 rock and 33 alluvial (reconnaissance pan) samples. Rock samples consisted of: 1) random chip -- taken at random intervals from homogeneous outcrops; and 2) continuous chip -- taken across a vein or mineralized zone. Reconnaissance pan samples consisted of two 14-inch level pans-full, or approximately 0.006 m^3 (cubic meter) of alluvium.

Partially field-concentrated alluvial (placer) samples were checked for fluorescence and radioactivity and further concentrated on a laboratory-sized shaking table at USBM's WFOC (Western Field Operations Center), Spokane, Wash., and examined for free gold and other heavy minerals. A split of the concentrates was sent to IGAL, Inc., Analytical Services Division, Cheney, Wash., for geochemical analysis. Digestion for minor elements analysis was by Aqua Regia; sample splits prepared for whole rock analysis were fused with lithium tetra and meta borate at 1000°C. Concentrations of 12 elements (table A-1) in rock samples or placer concentrates were determined by AA (atomic absorption), except As (arsenic) and Sb (antimony) were determined by organic extraction, and W (tungsten) and Mo (molybdenum) were by ICP (inductively coupled plasma-emission spectroscopy). Whole rock analysis was for major elements by AA, except Ca (calcium), Mg (magnesium), and Ti (titanium) were by ICP; concentrations were converted to percent of equivalent oxide.

ACKNOWLEDGEMENTS

The author would like to thank Victoria E. Mitchell of the Idaho Geological Survey, Moscow, Idaho, for help with the prefield and library research portion of this study. Allan Buehler, USBM, ably assisted in the field.

MINING HISTORY

Regional History

Mining activity in the region was centered southwest of the study area, in the White Knob Mountains southwest of Mackay, where copper was discovered around Alder Creek in 1879 (Wells, 1983, p. 123). Additional discoveries caused several mining camps to spring up south and west of Houston, present day Mackay, in 1884, and copper smelting began at one

of the camps, Cliff City. In 1888, discoveries of 35% to 55% copper across a 35-ft vein in Copper Basin, 20 km southwest of Mackay (fig. 1), sparked much additional interest and capital. The development of the White Knob mine in 1899, 6 km southeast of Mackay, caught the interest of John W. Mackay, a developer of the Comstock lode in Virginia City, Nevada. Mackay brought new capital and was instrumental in bringing the Union Pacific Railroad to Mackay. By 1914, when copper prices dropped, the White Knob produced $3.75 million; secondary recovery of low grade ore left behind in stopes continued until 1920.

The volcanic terrane that hosts copper deposits in the White Knob Mountains is not predominant in the Lost River Range, which contains the study area. There are three minor prospect areas north of Mackay. They were mainly for silver-lead-zinc, and date back to the 1880's. During the 1960's there was exploration for barite in the region. The prospects are discussed in detail by Capstick and others (1987).

Study Area History

Five prospects occur in, and adjacent to, the King Mountain study area. The Pass Creek prospect is outside, but along the northwest boundary of the study area; it was reported on by Capstick and others (1987) and McHugh and others (1991, p. 249, no. 633), but apparently little is known of its history. The prospect occurs in volcanic terrane reminiscent of the Mackay district, and was probably explored for copper.

The Elbow Quartz silica prospect consists of a 30-claim group in the lower part of Elbow Canyon. The claim group was located by Kenneth, Terry, Ronald, and Henry Williams, along with Harold Lambert and John F. McKelvey, all of Mackay, Idaho, in 1976 and relocated in 1990, according to BLM (U.S. Bureau of Land Management) recordation data. There has been no recorded production.

The Dutch Wonder lode group of two claims was located by Sherman and Frank Altmiller of Soda Springs, Idaho, in 1974. According to BLM records, the claims were actively held about eight years.

The Sands claims were a group of eight claims located at the head of Sands Canyon in 1980 by Bill K. Yearsly, Frank Byrd, and William S. Edington of Menan, Idaho. The claims were actively held for only a year.

The Earth Slide claims were located about 5 km north of King Mountain in 1984 by R. Dale Merrill and Chris A. Merrill of Moore, Idaho. The claims were actively held for two years.

GEOLOGIC SETTING

The King Mountain study area is predominantly underlain by Paleozoic marine limestone and lesser dolostone, with a relatively small inlier of silica-rich Ordovician quartzite. There are vast, un-quantified resources of these industrial minerals present (fig. 2); however, special markets need to develop for these resources, and be near enough for transportation costs to be competitive. Table 1 presents some general specifications for selected limestone markets. There is little evidence to suggest significant secondary metallic mineralization, although in an area as large, and geologically complex as the study area, such deposits cannot be ruled-out.

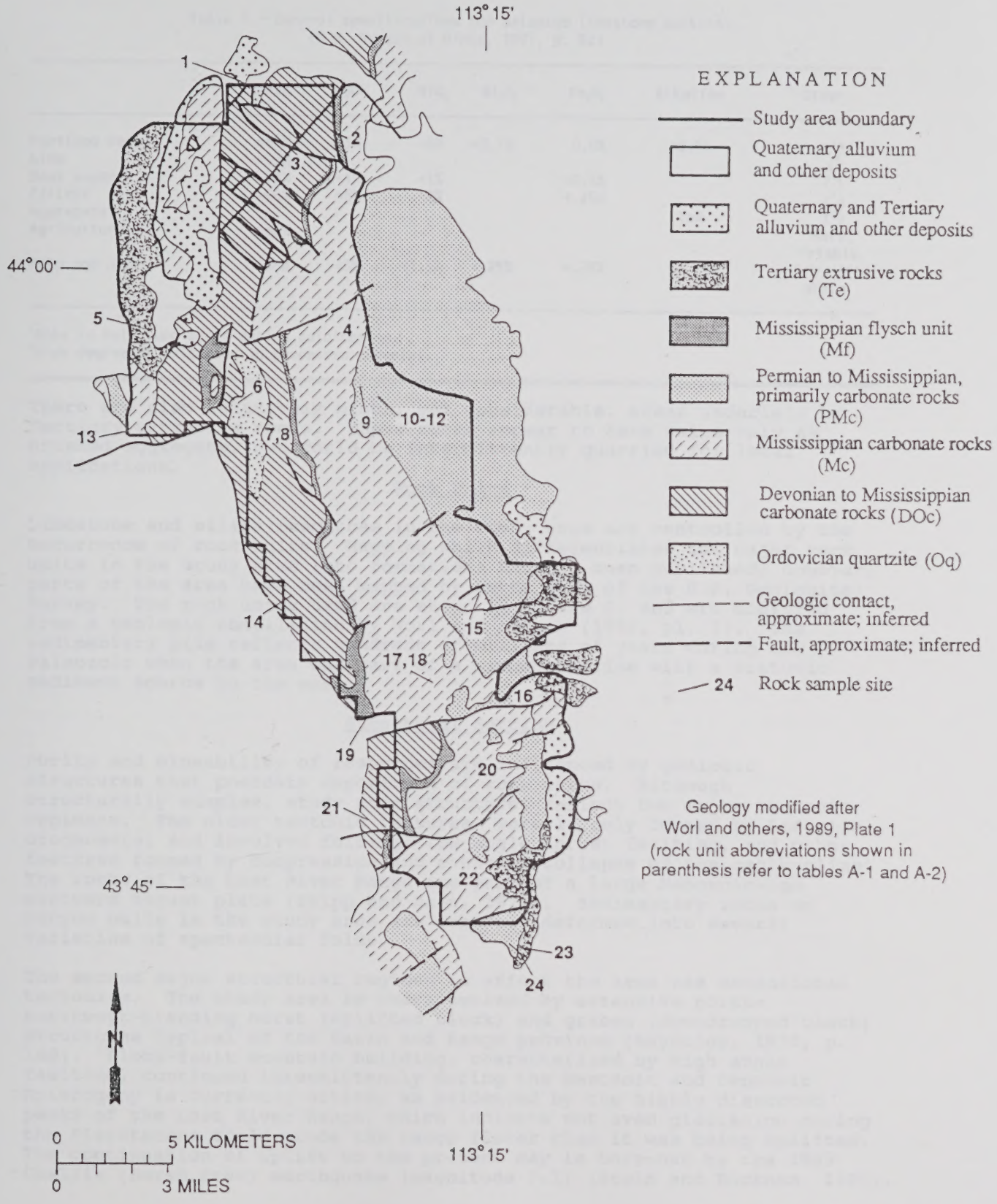

Figure 2.- Rock sample localities, and geology, King Mountain study area, Butte County, Idaho

Table 1.--General specifications for selected limestone markets
(U.S. Bureau of Mines, 1991, p. 82)

	$CaCO_3$	MgO	SiO_2	Al_2O_3	Fe_2O_3	Alkalies	Other
Portland cement	>82%	<3%	<5%	<3.7%	0.0%	<0.5%	(1)
Lime	>97%						(1)
Beet sugar	>96%	<1%	<1%		<0.5%		(1)
Fillers	>96%	<8%	<2%		<.25%		(1)
Aggregate							(1)
Agriculture	>85%					low	(2)
Pulp and paper	>96%	<3%	<1.5%	<.25%	<.25%		Soft, friable. Dry, fine grain

[1]Able to hold lump shape during calcination.
[2]High degree of whiteness in processed material.

There are also relatively minor, yet considerable, areas underlain by Tertiary extrusive rocks. These rocks appear to have value only as crushed aggregate, but could be intermittently quarried for local applications.

Rock Units

Limestone and silica resources in the study area are controlled by the occurrence of rock units. Mapping which differentiates the major rock units in the study area into formations has not been published; however, parts of the area have been mapped by Betty Skip of the U.S. Geological Survey. The rock units used are shown in figure 2, and are modified from a geologic compilation by Worl and others (1989, pl. 1). The sedimentary pile reflects hundreds of millions of years during the Paleozoic when the area was part of a miogeosyncline with a cratonic sediment source to the east.

Structural Setting

Purity and mineability of resources are influenced by geologic structures that postdate deposition of rock units. Although structurally complex, study area structures reflect two major tectonic regimens. The older tectonic features were largely formed by Laramide orogenesis, and involved folding, low angle thrust faulting, and other features formed by compression and eventual collapse of the geosyncline. The rocks of the Lost River Range are part of a large Mesozoic-age eastward thrust plate (Skipp and Hait, 1977). Sedimentary rocks on canyon walls in the study area are commonly deformed into several varieties of spectacular folds.

The second major structural regimen to affect the area was extensional tectonics. The study area is characterized by extensive north-northwest-trending horst (uplifted block) and graben (downdropped block) structures typical of the Basin and Range province (Reynolds, 1979, p. 188). Block-fault mountain building, characterized by high angle faulting, continued intermittently during the Mesozoic and Cenozoic. Epierogeny is currently active, as evidenced by the highly dissected peaks of the Lost River Range, which indicate not even glaciation during the Pleistocene could erode the range faster than it was being uplifted. The continuation of uplift to the present day is born-out by the 1983 Challis (Borah Peak) earthquake (magnitude 7.1) (Stein and Bucknam, 1985).

Geomorphology

The study area was intensely glaciated during the Pleistocene. The glaciation formed large and spectacular U-shaped valleys. The modern valleys are characterized by undersized seasonal streams, or no streams at all, due to alpine karst topography, which is best developed over areas of pure limestone. The major portion of the area is drained through subsurface solution channels in the limestone. Streams emerge gushing from springs peripheral to the range, two such spectacular springs occur at the headwaters of Deer Creek at the northeast corner of the range; there are, however, many kilometers of valley above these springs that only rarely see runoff.

PROSPECTS

Five prospects were examined (fig. 3). Rock sample localities at the prospects, and elsewhere, are shown on figure 2 (nos. 1-24), and alluvial (placer) sample localities are shown on figure 3 (nos. 25-57). Analytical results are in tables A-1 and A-2.

Pass Creek

One rock sample (no. 1) was taken from the dump of the Pass Creek prospect (fig. 3, no. 1). The quartz dacite sample was marked by light green stains suspected to be malachite, a copper mineral; analysis indicated only 9 ppm copper, however, suggesting the stains may have been a variety of chlorite. A sample from the same dump reported by Capstick and others (1987, p. 33) contained 2.8 g/t (0.1 oz/ton) silver.

Elbow Quartz (Silica)

The Elbow Quartz silica prospect (fig. 3, no. 2; and fig. 4) occurs in Ordovician quartzite. The only working seen consisted of a 60-m-long cut in pure- white quartzite at the junction of the north and east branches of Elbow Canyon. One grab sample (no. 6) collected along the length of the cut, contained 98.4% SiO_2 (silica) and 0.04% Fe_2O_3 (iron oxide), pure enough for metallurgical silica markets (U.S. Bureau of Mines, 1991, p. 105. A sample (no. 7) from another outcrop was of material too calcareous for many silica applications. A third sample (no. 8) from a silty brown interbed contained a trace of gold (5 ppb).

There is a large, un-quantified silica resource on the claim block and in the surrounding vicinity underlain by Ordovician quartzite, and units meeting various market specifications need to be further defined. Development of specific markets would have to precede further work on the deposit. Like other industrial minerals, silica products are geared to customer specifications, and the product needs to be close enough to the customer to compete successfully. All quartzite currently mined in Idaho for metallurgical use is mined and consumed by Monsanto Co. and FMC Corp.; none is marketed for any other uses (U.S. Bureau of Mines, 1991, p. 105).

Dutch Wonder Claims

The Dutch Wonder claims were located in the W1/2, Sec. 3, T. 7 N., R. 26 E. (fig. 3, no. 3), an area which occupies the east face of a 3,236-m-high (10,963 ft) peak. About 65% of this half section is above 3,000 m; the remaining lower areas mainly are part of two northeast-facing cirque walls. The area is underlain by light-blue-gray Mississippian limestone. No workings, other evidence of exploration, or mineralization was observed.

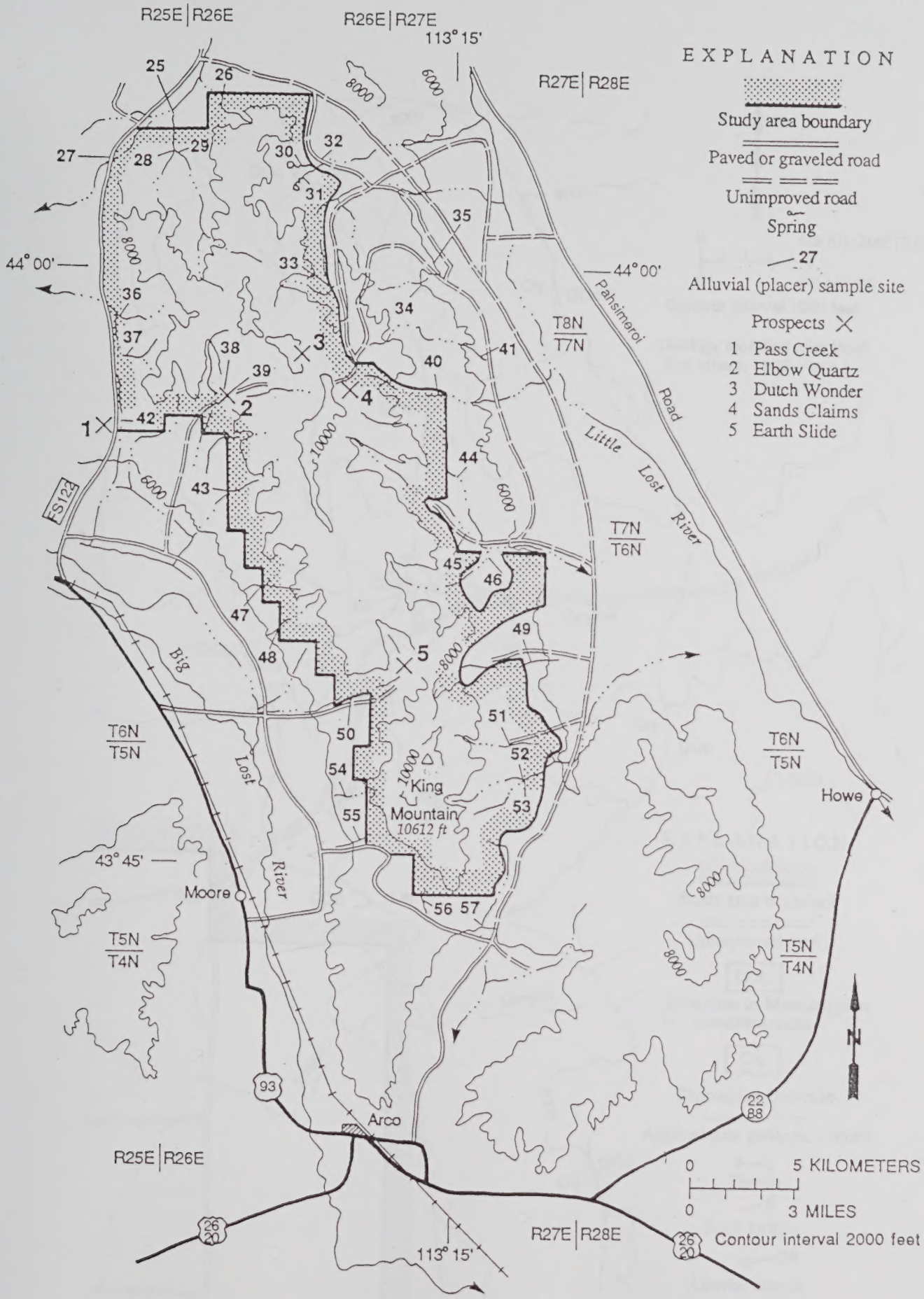

Figure 3.- Prospects, placer sample localities, and topography, King Mountain study area, Butte County, Idaho

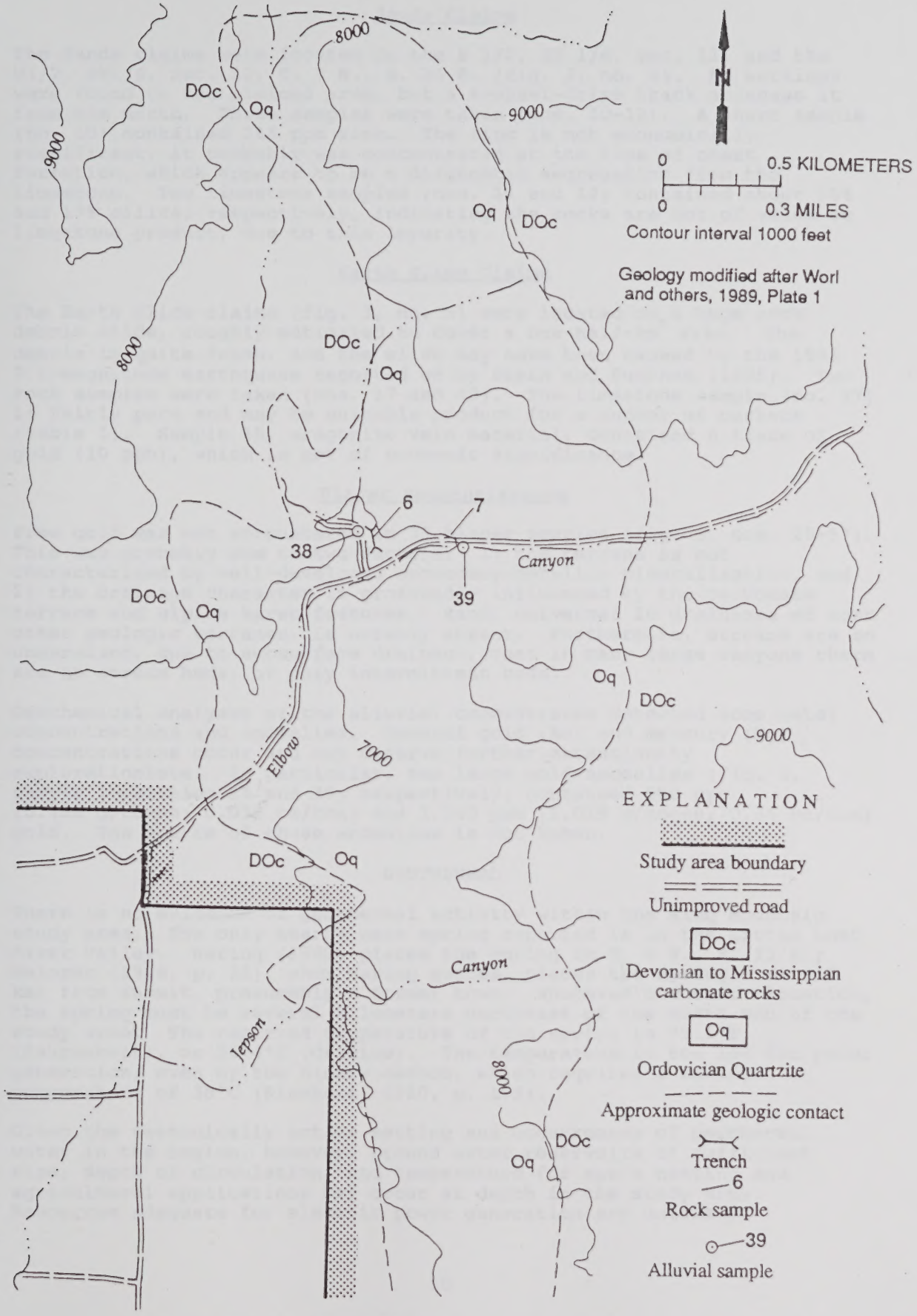

Figure 4.- Elbow Canyon silica prospect

Sands Claims

The Sands claims were located in the E 1/2, SE 1/4, Sec. 11, and the W1/2, SW1/4, Sec. 12, T. 7 N., R. 26 E. (fig. 3, no. 4). No workings were found on the claimed area, but a 4-wheel-drive track accesses it from the north. Three samples were taken (nos. 10-12). A chert sample (no. 10) contained 245 ppm zinc. The zinc is not economically significant; it probably was concentrated at the time of chert formation, which appears to be a diagenetic segregation from the limestone. Two limestone samples (nos. 11 and 12) contained about 35% and 17% silica, respectively, indicating the rocks are not of value as limestone product, due to this impurity.

Earth Slide Claims

The Earth Slide claims (fig. 3, no. 5) were located on a huge rock debris slide, roughly estimated to cover a one-half-km^2 area. The debris is quite fresh, and the slide may have been caused by the 1983 7.1-magnitude earthquake reported on by Stein and Bucknam (1985). Two rock samples were taken (nos. 17 and 18). The limestone sample (no. 17) is fairly pure and may be suitable product for a number of markets (table 1). Sample 18, aragonite vein material, contained a trace of gold (10 ppb), which is not of economic significance.

Placer Reconnaissance

Free gold was not encountered in 33 placer samples (fig. 3, nos. 25-57). This was probably due to two factors: 1) the terrane is not characterized by well-developed secondary metallic mineralization, and 2) the drainage character is profoundly influenced by the carbonate terrane and alpine karst features. Sand, universal in drainages of most other geologic terranes, is notably absent. Furthermore, streams are so undersized, due to subsurface drainage, that in many large canyons there are no stream beds, or only intermittent beds.

Geochemical analyses of the alluvial concentrates detected some metal concentrations and anomalies. Several gold (Au) and mercury (Hg) concentrations occur and may deserve further attention by explorationists. In particular, two large gold anomalies (fig. 3, sample localities 25 and 39, respectively) contained 590 ppb (0.483 g/tonne; 0.016 oz/ton) and 1,240 ppb (1.015 g/tonne; 0.36 oz/ton) gold. The source of these anomalies is not known.

GEOTHERMAL

There is no evidence of geothermal activity within the King Mountain study area. The only nearby warm spring reported is in the Little Lost River Valley. Waring (1965) places the spring in T. 9 N., R. 27 E.; Meinzer (1924, p. 32), whom Waring quotes, places the spring 6 mi (10 km) from Summit, presumably a former town. Whatever the exact location, the spring must be several kilometers northeast of the north end of the study area. The reported temperature of the spring is 79.5°F (Fahrenheit), or 26.4°C (Celsius). The temperature is too low for power generation, even by the binary method, which requires a minimum temperature of 38°C (Rinehart, 1980, p. 199).

Given the tectonically active setting and occurrences of geothermal water in the region, however, ground water reservoirs of sufficient size, depth of circulation, and temperature for space heating and agricultural applications may occur at depth in the study area. Resources adequate for electric power generation are unlikely.

EVALUATION

There are vast un-quantified resources of limestone, dolostone, and metallurgical-grade silica (quartzite) within the King Mountain study area. However, resources of the industrial minerals are also available nearby, outside the study area. There is little evidence to suggest significant secondary metallic mineralization, although in an area as large, and geologically complex as the study area, such deposits cannot be ruled-out. Geothermal resources adequate for power generation are unlikely.

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APPENDICES

TABLE A-1. -- Trace element analyses of samples from the King Mountain study area, Butte County, Idaho

[Gold value at $11.25 per gram, ppb - parts per billion, g - gram, m^3 - cubic meters, cm - centimeter, mm - millimeter, bld - boulders, cbl - cobbles, pbl - pebbles, sd - sand, slt - silt, cly - clay, org - organics; * - rock units (fig. 2); lms - limestone, vlc - volcanic extrusive, qtz - quartz, < - less than, > - larger than, Fe stns - iron stains, do.. - ditto]

Sample no.	Description	Sample type and length; *rock unit; gold value at $11.25/g	In parts per million, except as noted											
			Au (ppb)	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Bi	Mo	Hg (ppb)
Part I, Rock Samples (fig. 2):														
1	Volcanic mudflow breccia; self-supporting seriate clasts (70%) from boulder- to sand-sized, mainly carbonate (minor quartzite); red matrix (30%) composes sample and includes sand-sized clasts.	Random chip; *Te	<5	<0.2	10	<2	43	45	<5	<10	72	<5	1	40
2	Brownish gray, fine-grained calcarenite cross-bedded siltstone, weathers brown.	Grab; *Mf	<5	<.2	5	2	21	5	<5	<10	145	<5	1	10
3	Biosparrudite; self-supporting spirifired gray clasts in lighter gray matrix; flat cliff face strikes N.-S., dips 80° E., parallel to bedding, tectonic foliation, and possible range-front fault.	Random chip; *DOc	7	<.2	7	3	9	9	<5	<10	320	<5	<1	15
4	Blocky, light- to medium-gray limestone, apparent strike N. 10° W., dip 54° NE.	Random chip; *Mc	<5	<.2	6	<2	28	13	<5	<10	12	<5	<1	35
5	Light green to greenish gray Challis rhyodacite; 40% qtz phenocrysts <2mm across, 4% hornblende, 3% biotite.	Grab; *Te	<5	<.2	9	17	29	8	<5	<10	107	<5	<1	15
	-- Elbow Quartz silica prospect: ----													
6	Medium- to fine-grained homogeneous white quartzite; very minor Fe stns.	Grab; *Oq	<5	<.2	2	3	2	7	<5	<10	25	<5	1	25
7	Medium- to fine-grained, homogeneous, buff-colored quartzite; moderate Fe stns; bedding strikes N.-S., dips 43° W., 1st and 2nd order joints strike N. 85° E., dip 89° SE., and N.-S., dip 87° E.	do..	<5	<.2	3	3	4	18	<5	<10	180	<5	1	20
8	Light brown, argillaceous quartzite interbed, weathers buff-white; bed strikes N. 10° E., dips 60° SE., cross-bedding strikes N. 15° W., dips 25° SW., jointing strikes N. 77° E., dips 90°, along 6 mm-wide qtz veins.	Chip, 27cm; *Oq	5	<.2	6	6	8	22	<5	<10	185	<5	1	30

9	Bluish- to light-gray fetid biosparrudite; bryozoan, brachiopod, and crinoidal clasts.	Random chip; *PMc	<5	<.2	7	6	52	<5	<5	<10	36	<5	<1	25
	-- Sands claims: ----------													
10	Limonite-colored (yellowish-brown) chert and flint.	Grab; *PMc	<5	<.2	22	3	245	<0.2	22	3	245	<0.2	22	3

TABLE A-1. -- Trace element analyses of samples from the King Mountain study area, Butte County, Idaho -- continued

Sample no.	Description	Sample type and length; gold value at $11.25/g	In parts per million, except as noted											
			Au (ppb)	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Ba	Mo	Hg (ppb)
Part I, Rock Samples -- continued:														
	-- Sands claims -- continued: -------													
11	Light-gray, locally cross-bedded and locally fossiliferous limestone.	Grab; *PMc	<5	<0.2	5	<2	34	5	<5	<10	32	<5	<1	<10
12	Charcoal-gray, fetid, and commonly fossiliferous limestone.	do..	<5	<.2	7	<2	28	6	<5	<10	27	<5	<1	<10
	-- Pass Creek prospect: ----------													
13	Dull green qtz dacite; local hornblende and smokey qtz-eye phenocrysts.	Grab; *Te	<5	<.2	9	16	40	<5	<5	<10	192	<5	<1	20
14	Biosparrudite; gray fossil hash in light-gray matrix.	Random chip; *DOc	5	<.2	5	4	2	<5	<5	<10	48	<5	1	35
15	Medium-dark bluish-gray, moderately fetid limestone; rugose corals and crinoid stems; local Fe stns.	Random chip; *Mc	<5	<.2	6	<2	19	<5	<5	<10	12	<5	1	10
16	Medium-gray qtz dacite, weathers reddish brown; 10% very fine vesicules; uncommon qtz phenocrysts.	Random chip; *Te	<5	<.2	21	2	53	<5	<5	<10	280	<5	1	15
	-- Earth Slide prospect: ----------													
17	Dark-gray fetid limestone; very minor Fe stns.	Grab; *Mc	<5	<.2	6	<2	16	<5	<5	<10	15	<5	<1	15
18	Aragonite and hematite vein material from limestone; open-space-filling.	do..	10	<.2	9	<2	55	40	<5	<10	92	<5	<1	15
19	Brownish gray, thin-bedded limy siltsone, weathers brown to reddish brown.	Grab; *Mf	<5	<.2	7	4	30	6	<5	<10	197	<5	<1	10
20	Medium-gray limestone with brown-weathering chert nodules; crinoid stems, rugose coral, bryozoa, and a few brachiopods.	Random chip; *PMc	<5	<.2	6	<2	17	<5	<5	<10	51	<5	<1	<10
21	Silty-appearing buff-gray limestone; appears to be tectonically fragmented into hand-sized blocks and recemented.	do..	<5	<.2	4	<2	7	<5	<5	<10	78	<5	<1	20
22	Medium-dark gray phosphatic limestone; bryozoa, crinoid stems, and rugosa; pyrite, goethite, and locally cherty.	Grab; *Mc	<5	<.2	6	<2	17	15	<5	<10	62	<5	1	<10
23	Greenish-buff hornblende epidote chlorite dacite, weathers reddish brown; 1-mm vesicules.	Grab; *Te	<5	<.2	34	3	50	<5	<5	<10	238	<5	1	30
24	Medium-dark gray dolostone (75%) and light gray chert (25%); few fossils, possible crinoid stems; anastomosing hairline cly veinlets and local 6-24-mm-thick calcite veins; chert decreases down section.	Random chip; *PMc	<5	<.2	5	<2	17	<5	<5	<10	35	<5	1	10

TABLE A-1. -- Trace element analyses of samples from the King Mountain study area, Butte County, Idaho -- continued

Sample no.	Description	Free gold in g/m ; value in $0.00/m^3	In parts per million, except as noted											
			Au (ppb)	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Ba	Mo	Hg (ppb)
Part II, Alluvial (placer) Samples (analyses are of concentrates):														
25	65% > pea-size (6mm): 10% cbl, 55% pbl. < pea-size: 20% small pbl and granules, 15% slt, cly and org. Lms clasts with uncommon quartzite and volcanic rocks.	--	590	<0.2	10	8	33	10	<5	<10	520	<5	<1	45
26	40% > pea-size (6mm): 10% cbl, 30% pbl. < pea-size: 20% small pbl and granules, 10% slt and sd, 30% cly and org. Lms clasts.	--	<5	<.2	13	45	14	17	<5	<10	257	<5	1	30
27	65% > pea-size (6mm): 20% cbl, 40% pbl. < pea-size: 15% small pbl and granules, 10% sd, 10% slt, 5% cly and org. 80% vlc and 20% lms clasts.	--	<5	<.2	14	12	65	12	<5	<10	415	<5	<1	80
28	45% > pea-size (6mm): 5% cbl, 40% pbl. < pea-size: 15% small pbl and granules, 40% slt, cly and org. 95% Lms and 5% vlc clasts.	--	<5	<.2	10	3	40	<5	<5	<10	380	<5	<1	90
29	50% > pea-size (6mm): 5% cbl, 40% pbl. < pea-size: 10% small pbl and granules, 40% slt, cly and org. 95% Lms and 5% quartzite clasts.	--	23	<.2	9	9	29	<5	<5	<10	312	<5	<1	145
30	50% > pea-size (6mm): 5% cbl, 40% pbl. < pea-size: 10% small pbl and granules, 40% slt, cly and org. 95% Lms and 5% chert clasts.	--	<5	<.2	8	7	20	6	<5	<10	138	<5	1	35
31	60% > pea-size (6mm): 5% bld, 15% cbl, 40% pbl. < pea-size: 10% small pbl, 10% sd, 10% slt, and 10% cly and org. 95% lms and 5 % chert clasts.	--	30	<.2	7	4	20	11	<5	<10	127	<5	1	185
32	60% pbl > pea-size (6mm); 40 % < pea-size (slt, cly, org). 85% lms and 15% chert clasts.	--	6	<.2	9	5	34	5	<5	<10	180	<5	<1	30
33	60% > pea-size (6mm): 5% bld, 15% cbl, 40% pbl. < pea-size: 10% small pbl and 10% sd, 10% slt, 10% cly and org. 90% lms, 5 % chert, and 5% quartzite clasts.	--	<5	<.2	9	5	70	5	<5	<10	430	<5	1	40
34	65% > pea-size (6mm): 5% bld and cbl, 60% pbl. < pea-size: 20% slt, 15% cly and org. 90% lms and 10% chert.	--	<5	<.2	7	<2	49	<5	<5	<10	78	<5	1	20
35	80% > pea-size (6mm): 10% bld and cbl, 70% pbl. < pea-size: 10% slt, 10% cly and org. 95% lms and 5% chert.	--	<5	<.2	8	<2	51	<5	<5	<10	120	<5	<1	<10
36	50% pbl > pea-size (6mm). < pea-size: 50% slt, cly, and org. 80% lms and 20% vlc clasts.	--	12	<.2	8	13	138	<5	<5	<10	615	<5	<1	40
37	Similar to sample 36	--	25	<.2	11	107	81	5	<5	<10	420	<5	<1	50
38	60% > pea-size (6mm): 20% bld and cbl, 40% pbl. < pea-size: 20% pbl, 20% slt, cly, and org. 85% lms and 15% quartzite.	--	30	<.2	16	30	29	9	<5	<10	152	<5	<1	25

TABLE A-1. -- Trace element analyses from the King Mountain study area, Butte County, Idaho -- continued

Sample no.	Description	Free gold in g/m ; value in $0.00/m³	In parts per million, except as noted											
			Au (ppb)	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Ba	Mo	Hg (ppb)
Part II, Alluvial (placer) Samples (analyses are of concentrates) - continued:														
39	40% > pea-size (6 mm): 10% bld, 10% cbl, 20% pbl; < pea-size: 35% small pbl and granules, 25% slt, cly and org. 70% lms, 30% quartzite clasts.	--	1240	<0.2	13	14	31	13	<5	<10	160	<5	1	45
40	20%, 6-25 mm, subangular lms pbl, 80% slt, cly, and org.	--	10	<.2	9	2	62	<5	<5	<10	140	<5	<1	30
41	40% > pea-size (6 mm): 10% bld, 10% cbl, 20% pbl. < pea-size: 10% small pbl and granules, 50% slt, cly and org. Almost all lms clasts.	--	25	<.2	8	3	50	<5	<5	<10	272	<5	2	375
42	40% pbl > pea-size (6 mm). < pea-size: 40% small pbl and 20% slt, cly, and org. 70% lms, 15% dacite, and 15% qtz.	--	12	<.2	10	9	87	<5	<5	<10	345	<5	<1	105
43	70% > pea-size (6 mm): 10% bld, 20% cbl, 30% pbl. < pea-size: 30% slt, cly, and org. Almost all lms clasts.	--	13	<.2	15	9	75	15	<5	<10	225	<5	1	320
44	50% > pea-size (6 mm): 10% cbl, 40% pbl. < pea-size: 15% small pbl, 15% granules, 10% slt, 10 cly and org. All Lms clasts, 10% Fe stained.	--	10	<.2	8	3	44	5	<5	<10	133	<5	<1	35
45	40% > pea-size (6 mm): 5% bld, 10% cbl, 25% pbl. < pea-size: 20% slt, 30% cly and org. All subangular lms clasts.	--	20	<.2	8	3	48	12	<5	<10	127	<5	<1	25
46	60% > pea-size (6 mm): trace cbl, rest all pbl. < pea-size: 10% pbl, 30% slt, cly, and org. All lms clasts.	--	<5	<.2	10	2	65	11	<5	<10	182	<5	<1	15
47	75% > pea-size (6 mm): 20% bld, 35% cbl, 20% pbl; < pea-size: 15% small pbl and granules, 10% slt, cly, and org. 90% dolostone, 5% chert, and 5% siltstone.	--	5	1.1	35	8	160	17	<5	<10	85	<5	2	60
48	70% > pea-size (6mm): 10% bld, 15 cbl, 45% pbl. < pea-size portoin Fe stained: 15% slt, 15 % cly and org; lms clasts.	--	8	<.2	12	30	59	17	<5	<10	183	<5	1	100
49	60% > pea-size (6mm): 15 cbl, 45% pbl. < pea-size: 10% pbl and granules, 15% slt, 15 % cly and org. Clasts 80% lms and 20% vlc.	--	<5	<.2	12	10	130	6	<5	<10	445	<5	<1	15
50	70% > pea-size (6mm): 20% cbl, 50% pbl. < pea-size fraction Fe stained: 15% slt, 15 % cly and org; All lms clasts.	--	<5	<.2	10	14	33	16	<5	<10	158	<5	<1	125
51	45%, 6-25-mm subangular lms pbl, 55% slt, cly, and org.	--	<5	<.2	11	7	101	18	<5	<10	203	<5	1	25
52	45% > pea-size (6mm): 15 cbl, 30% pbl. < pea-size: 25% pbl and granules, 15% slt, 15 % cly and org. All lms clasts.	--	<5	<.2	8	2	48	6	<5	<10	148	<5	<1	20
53	40% pbl > pea-size (6mm). < pea-size: 20% small pbl and granules, 20% slt, 20% cly and org. All lms clasts.	--	<5	<.2	21	7	66	<5	<5	<10	485	<5	<1	60
54	45% pbl > pea-size (6mm). < pea-size: 15% small pbl and granules, 20% slt, 20% cly and org. All lms clasts.	--	<5	<.2	13	16	48	12	<5	<10	132	<5	1	50

TABLE A-1. -- Trace element analyses from the King Mountain study area, Butte County, Idaho -- continued

Sample no.	Description	Free gold in g/m³; value in $0.00/m³	In parts per million, except as noted											
			Au (ppb)	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Ba	Mo	Hg (ppb)
Part II, Alluvial (placer) Samples (analyses are of concentrates) - continued:														
55	70% > pea-size (6mm): 20% cbl, 50% pbl. < pea-size fraction Fe stained: 15% slt, 15 % cly and org. All lms clasts.	--	5	<0.2	11	12	28	12	<5	<10	172	<5	2	135
56	60% > 6-mm, angular, lms pbl. < pea-size: 5% pbl and granules, 15% slt, 20% cly and org.	--	10	.6	10	26	62	14	<5	<10	250	<5	<1	30
57	60% > pea-size (6mm): 20 cbl, 40% pbl. < pea-size: 15% pbl and granules, 10% slt, 15 % cly and org. Clasts 70% lms and 30% vlc.	--	<5	<.2	12	4	60	<5	<5	<10	310	<5	<1	45

Table A-2.--Whole rock analyses of samples from the King Mountain study area, Butte County, Idaho
[Analyses by plasma emission spectroscopy, except LOI (loss on ignition) by gravimetric analysis; * rock units shown on fig. 2]

Map no. (fig. 2)	Description	Sample type	In percent											
			Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	LOI	Totals
1	Volcanic mudflow breccia; self-supporting seriate clasts (70%) from boulder- to sand-sized, mainly carbonate (minor quartzite); red matrix (30%) composes sample and includes sand-sized clasts.	Random chip; *Te	1.72	35.70	0.67	0.57	0.51	0.011	0.02	0.16	30.95	0.12	29.10	99.53
2	Brownish gray, fine-grained calcarenite cross-bedded siltstone, weathers brown.	Grab; *Mf	3.55	13.20	.86	1.42	4.12	.021	.45	.08	61.83	.25	14.25	100.03
3	Biosparrudite; self-supporting spirifired gray clasts in lighter gray matrix; flat cliff face strikes N.-S., dips 80° E., parallel to bedding, tectonic foliation, and possible range-front fault.	Random chip; *DOc	1.12	49.85	.62	.46	.56	.057	.02	.02	5.46	.05	40.05	98.27
4	Blocky, light- to medium-gray limestone, apparent strike N. 10° W., dip 54° NE.	Random chip; *Mc	.23	53.65	.07	.07	.47	.003	.02	.08	2.18	.01	41.70	98.48
5	Light green to greenish gray Challis rhyodacite; 40% qtz phenocrysts <2mm across, 4% hornblende, 3% biotite.	Grab; *Te	12.05	2.35	1.78	5.13	.68	.022	1.38	.11	71.80	.28	4.45	100.03
	---- Elbow Quartz silica prospect: ----													
6	Medium- to fine-grained homogeneous white quartzite; very minor Fe stns.	Grab; *Oq	.20	.06	.04	.07	.02	.005	.01	.03	98.40	.01	.17	99.02
7	Medium- to fine-grained, homogeneous, buff-colored quartzite; moderate Fe stns; bedding strike N.-S., dip 43° W., 1st and 2nd order joints strike N. 85° E., dip 89° SE., and strike N.-S., dip 87° E.	do..	.32	6.20	.43	.17	2.95	.022	.01	.05	80.12	.02	9.15	99.44
8	Light-brown, argillaceous quartzite interbed, weathers buff-white; bed strikes N. 10° E., dips 60° SE., cross-bedding strikes N. 15° W., dips 25° SW., jointing strikes N. 77° E., dips 90°, along 6-mm-wide qtz veins.	Chip, 27cm; *Oq	.51	.35	.76	.16	.08	.018	.01	.06	95.80	.02	.93	98.70

9	Bluish- to light-gray fetid biosparrudite; bryozoan, brachiopod, and crinoidal clasts.	Random chip; *PMc	.61	39.20	.24	.36	.76	.006	.03	.21	26.10	.03	31.50	99.05
	---- Sands claims: ----------													
10	Limonite-colored (yellowish-brown) chert and flint.	Grab; *PMc	.16	1.20	2.13	.06	.11	.007	.02	.01	94.35	.01	1.45	99.51
11	Light-gray, locally cross-bedded and locally fossiliferous limestone.	Grab; *PMc	.52	31.25	.19	.27	3.02	.005	.03	.29	35.62	.05	27.30	98.55
12	Charcoal-gray, fetid, and commonly fossiliferous limestone.	do..	.26	43.80	.14	.13	1.02	.005	.03	.18	17.35	.01	35.25	98.18

Table A-2.--Whole rock analyses of samples from the King Mountain study area, Butte County, Idaho -- continued

Map no. (fig. 2)	Description	Sample type	In percent											
			Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	LOI	Totals
	-- Pass Creek prospect: ----------													
13	Dull green qtz dacite; local hornblende and smokey qtz-eye phenocrysts.	Grab; *Te	12.13	2.10	2.25	4.95	1.07	0.032	1.32	0.04	70.62	0.27	4.32	99.10
14	Biosparrudite; gray fossil hash in light-gray matrix.	Random chip; *DOc	.32	36.70	.15	.12	18.40	.008	.04	.05	1.02	.05	43.80	100.66
15	Medium-dark bluish-gray, moderately fetid limestone; rugose corals and crinoid stems; local Fe stns.	Random chip; *Mc	.16	53.35	.07	.05	.53	.002	.02	.09	2.60	.01	42.55	99.43
16	Medium-gray qtz dacite, weathers reddish brown; 10% very fine vesicules; uncommon qtz phenocrysts.	Random chip; *Te	13.85	10.12	13.02	.69	5.70	.17	.32	.28	54.60	1.75	.56	101.06
	-- Earth Slide prospect: ----------													
17	Dark-gray fetid limestone; very minor Fe stns.	Grab; *Mc	.18	53.70	.06	.04	.35	.003	.02	.04	2.45	.04	42.50	99.38
18	Aragonite and hematite vein material from limestone; open-space-filling.	do..	.38	51.05	2.35	.08	.48	.015	.02	.03	3.22	.03	40.35	99.01
19	Brownish gray, thin-bedded limy siltsone, weathers brown to reddish brown.	Grab; *Mf	3.97	12.15	1.05	1.85	.96	.029	.11	.07	60.92	.07	12.65	93.83
20	Medium-gray limestone with brown-weathering chert nodules; crinoid stems, rugose coral, bryozoa, and a few brachiopods.	Random chip; *PMc	.30	40.85	.26	.07	.40	.009	.04	.12	23.63	.02	31.82	97.52
21	Silty-appearing buff-gray limestone; appears to be tectonically fragmented into hand-sized blocks and recemented.	do..	.22	36.10	.15	.07	19.15	.014	.04	.07	.75	.01	43.25	99.82
22	Medium-dark gray phosphatic limestone; bryozoa, crinoid stems, and rugosa; pyrite, goethite, and locally cherty.	Random Grab; *Mc	.24	49.70	.12	.09	.28	.009	.02	.02	8.92	.02	39.45	98.87
23	Greenish-buff hornblende epidote chlorite decite, weathers reddish brown; 1-mm vesicules.	Grab; *Te	12.80	3.85	5.21	3.68	1.78	.055	3.21	.36	61.05	.61	1.93	94.54
24	Medium-dark gray dolostone (75%) and light gray chert (25%); few fossils, possible crinoid stems; anastomosing hairline cly veinlets and local 6-24-mm-thick calcite veins; chert decreases down section.	Random chip; *PMc	.21	41.20	.17	.06	.32	.007	.02	.08	22.17	.01	32.15	96.40